Temporary Diversions

Practice Description

A temporary ridge or excavated channel or combination ridge and channel designed to protect work areas from runoff and divert water to sediment traps or stable outlets. Temporary diversions are usually constructed by excavating a channel and using the excavated material to construct a ridge on the down slope side of the channel.

This practice applies wherever stormwater runoff must be temporarily diverted to protect disturbed areas and slopes or to retain sediment on site during construction. These structures generally have a life expectancy of 18 months or less, but can be prolonged with proper maintenance.

K. Grimes, SWCD. St. Charles Co.

An unfinished temporary diversion routes sediment-laden stormwater to a sediment basin. Temporary diversions should be shaped, seeded and mulched. Establish permanent vegetation if the diversion will be used for one year or more.

Recommended Minimum Requirements

Prior to start of construction, temporary diversions should be designed by a registered design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Temporary diversions should be constructed to minimize erosion at the design flow.

- **Drainage Area:** Less than 5 acres

- **Ridge Design:**
  Side Slope: 2:1 or flatter; 3:1 or flatter where vehicles must cross
  Top Width: 2.0 ft.
  Freeboard: 0.3 ft.
  Settlement: 10% of fill height

- **Channel Design:**
  Side Slope: 2:1 or flatter; 3:1 or flatter where vehicles must cross
  Grade: Stable, positive grade towards outlet, but not exceeding 2%

Construction

Site Preparation

Locate and mark the alignment of the diversion as shown on the plans. The alignment should maintain a stable, positive grade toward the outlet. Minor adjustments to the grade and alignment may be required by site conditions. Realign or elevate the diversion as needed to avoid reverse grade.

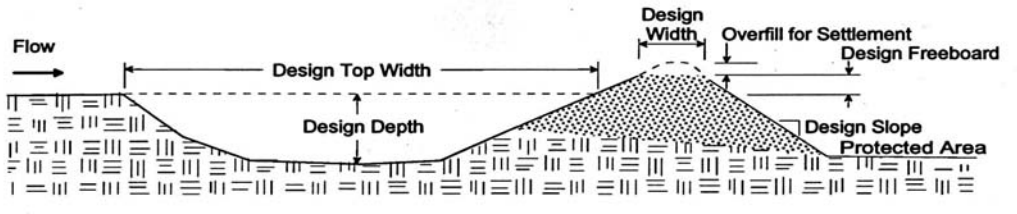


Figure 5.14 Typical Temporary Combination Diversion

Determine exact location of any underground utilities.

Remove trees, brush, stumps and other unsuitable material from site.

Disk the base of the ridge before placing fill.

Grading

Construct the diversion to dimension and grades shown on the design.

Build the ridge 10% higher than designed for settlement, and compact with wheels of the construction equipment or sheepsfoot roller.

Leave sufficient area along the diversion to permit clean out and re-grading.

Erosion Control

Stabilize the outlets in accordance with design plans during construction of the diversion.

Place gravel or other surface protection at vehicle crossings to prevent rutting.

Stabilize ridges and channels with vegetation or synthetic erosion control measures as specified in the design.

Outlet should be nonerosive for design flow. Divert flow containing sediment to sediment trap or basin.

Stabilize ridge with vegetation if in place more than 30 working days.

If the diversion is constructed above a steep slope, install temporary slope drains or other stable outlet to control runoff and prevent erosion of the slope (see *Temporary Slope Drains, Grass-lined Channel, Riprap-lined Channel*).

Construction Verification

The field inspector should verify the dimensions shown on the plans for the following: depth, bottom width, top width, side slopes of channel and ridge, grade of channel bottom, ridge height and channel stabilization techniques.

Check all of the finished grades and configuration of all channels to eliminate constrictions to flow. Also check all ridges for low spots and stability.

Troubleshooting

Consult with a registered design professional if any of the following occur:

- Seepage is encountered during construction. It may be necessary to install drains.
- Variations in topography on site indicate diversion will not function as intended.
- Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitutions may be required. Unapproved substitutions could result in erosion and lead to diversion failure.

Maintenance

Inspect weekly and following each storm event.

Remove debris and sediment from the channel and rebuild the ridge as needed.

Check outlets and make necessary repairs immediately.

Remove sediment from traps when they are 50% full.

When the work area has been stabilized, remove the ridge and fill in the channel to blend with the natural ground. Remove temporary slope drains and stabilize all disturbed areas with vegetation or other erosion control practices.

Mow grass in channel as shown in the design plan.

Common Problems

Sedimentation results in channel grade decreasing or reversing, leading to overtopping—realign or deepen the channel to maintain grade.

Low point in ridge where diversion crosses a natural depression results in overtopping of ridge—build up ridge.

Erosion in channel before vegetation is established results in uneven channel grade, may lead to breach of ridge—repair channel and install sod or synthetic liner.

Seepage or poor drainage in channel results in poor vegetation establishment—install subsurface drains or stone channel bottom.

Vehicle crossing point results in rutting, increased erosion potential—maintain the ridge height, flatten the side slopes, protect the ridge with gravel or hard surface at the crossing point.

Excessive grade in channel results in erosion in channel—repair channel, and install an erosion resistant lining or realign to reduce the grade.

Excessive velocity at outlet results in erosion—install an outlet stabilization structure (see *Rock Outlets* or *Energy Dissipators*).

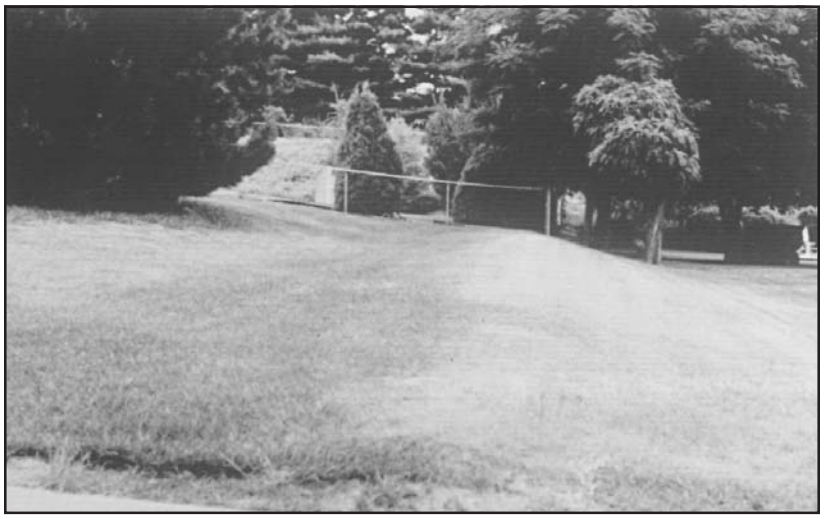
Ridge not compacted, runoff from a storm event may cause failure—repair and use construction equipment to compact.

Permanent Diversion

Practice Description

A watercourse constructed across a slope which may consist of an excavated channel, a compacted ridge or a combination of both. Most permanent diversions are constructed by excavating a channel and using the excavated material to construct a ridge on the downslope side of the channel.

This practice applies to wherever stormwater runoff can be redirected to protect downslope structures or areas from erosion, sediment, and excessive wetness or localized flooding. They are designed to intercept and carry excess water to a stable outlet where it can be temporarily stored or released.



W. E. Seffens. St. Charles Co.

Permanent diversions provide long-term protection for the areas below as they route runoff to a stable outlet. They also allow time for vegetation to become established on the protected slopes. Generally, fences, trees and other obstructions should not be located in the channel.

Recommended Minimum Requirements

Prior to start of construction, permanent diversions should be designed by a registered design professional. Plans and specifications should be referred to by field personnel throughout the construction process. The diversion should be built according to planned alignment, grade and cross section.

- **Drainage Area:** Less than 5 acres

- **Ridge Design:**
  Side Slopes: 2:1 or flatter; 3:1 or flatter where vehicles must cross
  Top Width: 2.0 ft. minimum
  Height: 1.5 ft.
  Freeboard: 0.5 ft.
  Settlement: 10% of fill height

- **Channel Design:**
  Shape: Parabolic, Trapezoidal or V-shaped
  Side Slopes: 2:1 or flatter; 3:1 or flatter where vehicles must cross
  Grade: Stable, positive grade towards outlet

- **Erosion Control:** Establish vegetation on ridges and channels as soon as possible or use synthetic erosion control measures as specified in the design.

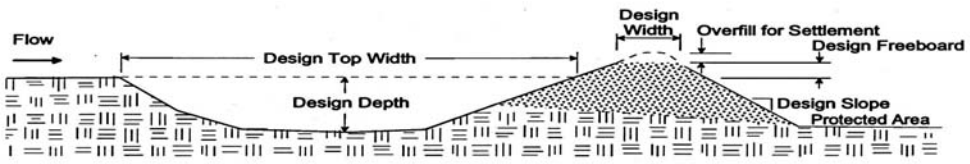


Figure 5.15 Typical Trapezoidal Permanent Diversion

Construction

Site Preparation

Determine exact location of any underground utilities.

Locate and mark the alignment of the diversion as shown on the plans. The alignment should maintain a positive grade towards the outlet. Minor adjustments to the grade and alignment may be required to meet site conditions.

Clear the construction area of trees, stumps, brush, sod and all other unsuitable material which would interfere with compaction of the ridge.

Disk or scarify the area where the ridge is to be installed before placing the fill.

Clean out, fill and compact all ditches, swales or gullies to be crossed.

Apply gravel or hard surface protection at vehicle crossings to prevent rutting.

Install vegetated outlets prior to construction. Adequate vegetation should be established in the outlet channel. If vegetation cannot be established, consider using erosion control blankets or constructing a stabilized outlet (See *Rock Outlets* and *Energy Dissipators*).

Grading

Excavate, fill, shape and stabilize the diversion to planned alignment, grade and cross section. The channel should have a positive grade toward the outlet to avoid ponding. Where possible, blend diversion into the surrounding landscape.

Overfill and compact the ridge, allowing for 10% settlement. The settled ridge top must be at or above design elevation at all points. Compaction may be achieved by driving wheeled equipment along the ridge as lifts are added. Fill should be placed in lifts of no more than 6 to 8 inches in depth.

Erosion Control

Leave sufficient area along the diversion to permit clean out and regrading.

Install gravel or hard surface protection at vehicle crossings.

Stabilize diversion outlets in accordance with plans.

Control sediment with silt fence (or other appropriate measures) along grading limits. Diversions carrying sediment from disturbed areas must empty into sediment traps or basins.

Immediately after installation use permanent vegetation or other means to stabilize the diversion in accordance with plans.

Construction Verification

Check finished grades and cross section of all channels to eliminate constrictions to flow. Also check all ridges for low spots and stability.

Troubleshooting

Consult with registered design professional if any of the following occur:

- Seepage is encountered during construction. It may be necessary to install drains.
- Variations in topography on site indicate diversion will not function as intended.
- Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitutions may be required. Substitutions not approved by the design professional could result in erosion and lead to diversion failure.

Maintenance

Inspect weekly and following each storm event for eroded areas until the diversion is vegetated, then periodically and after major storms.

Remove debris and sediment from the channel, and rebuild the ridge to design elevation where needed.

Check diversion outlets and keep in good repair to prevent erosion.

Maintain vegetation with periodic fertilization and mowing to keep plantings in a vigorous, healthy condition. Mowing for weed and brush control during the first year should generally be done at a height of 4 inches to prevent seedling damage.

When the a work area has been stabilized, remove sediment traps and repair bare or damaged areas in the vegetation.

Stabilize all eroded, rutted or disturbed areas as soon as possible with vegetation or synthetic erosion control measures as specified in the design.

Common Problems

Rutting at vehicle crossings; increases erosion potential—maintain ridge height, protect with gravel or hard surface or flatten side slopes.

Silt may accumulate in diversions resulting in channel grade decreases or reverses, leading to overtopping—remove silt in the channel to maintain grade.

Ridge overtops—diversions crossing natural depressions should be constructed to avoid dips in the ridge.

Erosion in channel before vegetation is established; results in uneven channel grade, may lead to breach of ridge—install sod or synthetic liner.

Seepage or poor drainage in channel; results in poor vegetation establishment—install subsurface drains.

Outlets not stabilized; results in scour at the diversion outlet—repair erosion, reevaluate erosive velocities and recommended erosion protection measures.

Perimeter Protection

Practice Description

A berm or channel constructed along the outside edge of a disturbed construction area to prevent damage from stormwater runoff or sediment. These diversions are used on the upslope side of a construction site to prevent surface runoff from entering the disturbed area. They can also be used on the downslope side to divert sediment-laden runoff to on-site sediment traps or basins. Diversions for perimeter protection can be either temporary or permanent.

N. Klopfenstein, NRCS. St. Charles Co.

Even when everything is done right (permanent seeding with a tackified mulch), a heavy rain can cause rills and gullies in cut-and-fill slopes. A diversion at the top of the slope could have prevented the need to regrade and reseed.

Recommended Minimum Requirements

Prior to start of construction, diversions should be designed by a registered design professional. Plans and specifications should be referred to by field personnel throughout the construction process. The diversion should be built according to planned alignment, grade and cross section.

- **Drainage Area:** Less than 5 acres

- **Berm Design:**
  Side Slopes: 2:1 or flatter; 3:1 or flatter where vehicles must cross
  Top Width: 2.0 ft.
  Height: 1.5 ft.
  Freeboard: 0.5 ft.
  Settlement: 10% of fill height

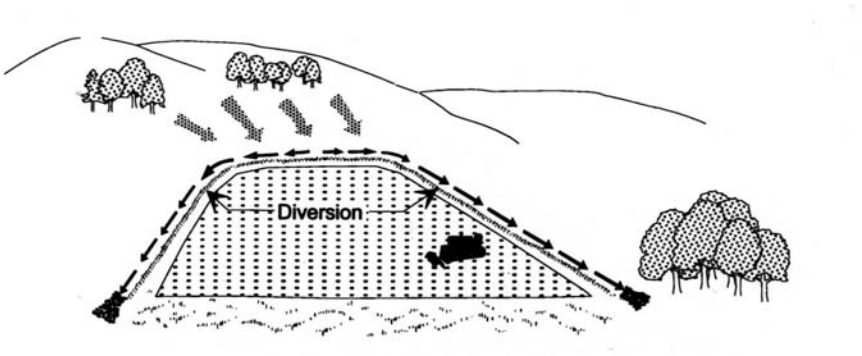


Figure 5.16 Typical Perimeter Protection

- **Channel Design:**
  Shape: Trapezoidal, Parabolic or V-shaped
  Side Slopes: 2:1 or flatter; 3:1 or flatter where vehicles must cross
  Stabilization: As specified in the design plan; based on velocity by reaches
  Grade: Stable, positive grade towards outlet, but not exceeding 2%

- **Outlet:** Stable, with sediment-laden water diverted to a sediment trap or basin; and runoff from undisturbed areas diverted to a stable natural outlet or outlet stabilization structure

Construction

Site Preparation

Determine exact location of any underground utilities.

Remove all trees, brush, stumps or other debris from the site, and dispose of properly.

Fill and compact all ditches or gullies to be crossed.

Scarify the base of the berm before placing the fill.

Grading

Fill the berm higher than the design elevation , and compact with wheels of the construction equipment to design height plus 10%.

Construct the channel to the dimensions and elevations shown on the plan.

Leave enough area along the diversion to permit access by machines for clean out and maintenance.

Install outlet protection and sediment traps according to the design plan.

Erosion Control

Stabilize the channel using temporary lining to protect vegetation as specified in the design plan.

Establish vegetation on the berm immediately following construction. If diversion is temporary, restore berm and channel to original grade after disturbed area is stabilized and establish vegetation as soon as possible.

Stabilize the disturbed areas.

Construction Verification

Check finished grade and cross section of berm or channel around the perimeter.

Check channel cross sections at several locations to eliminate constrictions to flow.

Troubleshooting

Consult with registered design professional if any of the following occur:

- Variations in topography on site indicate perimeter protection will not function as intended. Changes in plan may be needed.
- Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitution may be required. Unapproved substitutions could result in failure of the perimeter protection.

Maintenance

Inspect the berm periodically and after every storm event.

Remove debris and sediment from the channel immediately.

Repair the berm to its original height if damaged.

Check outlets and make necessary repairs to prevent gully formation.

Clean out sediment traps when 50% full.

Once the work area has been stabilized, remove the sediment traps, disposing of unstable sediment in a designated disposal area.

Common Problems

Erosion in channel from excessive grade—install an erosion-resistant lining in the channel.

Overtopping caused by sediment in channel where grade decreases or reverses—deepen the channel or realign the grade.

Overtopping at low point in ridge where diversion crosses shallow draw— rebuild the ridge with a positive grade towards the outlet at all points.

Erosion at outlet—install an outlet stabilization structure.

Sedimentation at diversion outlet—install a temporary sediment trap.

Temporary Swale

Practice Description

A linear depression in the ground surface which carries drainage run-off, but does not block traffic, as do ditches, gutters or diversions. This practice applies anywhere a drainage conveyance is required and can be used as an alternative to closed pipe systems. Grassed swales also provide the benefits of reducing stormwater velocity, promoting infiltration and removing sediment.

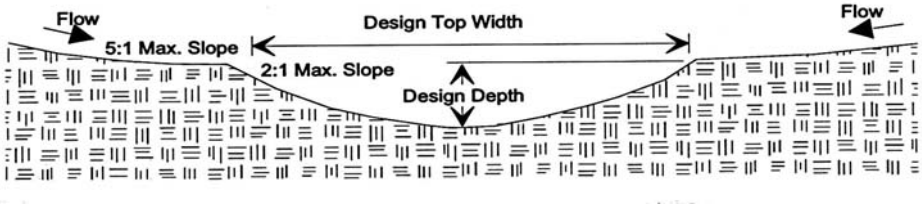


Figure 5.17 Cross Section of Typical Temporary Swale

Recommended Minimum Requirements

Prior to start of construction, temporary swales should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process. The swale should be built according to planned alignment, grade and cross section.

- **Drainage Area:** Less than 3 acres
- **Ground Slopes:** Ground slopes leading to the swale should have a grade of 5:1 or less

Construct temporary swales to minimize erosion at the design flow.

Construction

Site Preparation

Determine exact location of any underground utilities.

Locate and mark the alignment of the swale as shown on the plans. The alignment should maintain a positive grade towards the outlet to avoid

ponding. Minor adjustments to the grade and alignment may be required by site conditions.

Remove trees, brush, stumps and other debris from the site.

Grading

Excavate, fill and shape the swale to planned alignment, grade and cross section.

Erosion Control

Stabilize the outlets during the construction of the swale.

Seed, mulch or sod the swale immediately after construction.

Construction Verification

Check finished grade and cross section of swale throughout its length to ensure that it is free of constrictions and reverse grades.

Troubleshooting

Consult with a registered design professional if any of the following occur:

- Variations in topography on site indicate swale will not function as intended. Changes in the plan may be needed.
- Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitutions may be required. Unapproved substitutions could result in erosion and lead to failure.
- Poorly drained soils that contain high amounts of clay are found on the site. These types of soils may cause prolonged surface ponding of water.

Maintenance

Inspect following each storm event.

Remove sediment from the swale as needed.

Repair erosion damage immediately.

Check outlets and make necessary repairs immediately.

Common Problems

Vehicle crossing point; can cause rutting and increase erosion—flatten the side slopes and protect the swale with gravel at the crossing point.

Excessive grade in channel; results in channel erosion—realign to reduce the grade.

Excessive velocity at outlet; results in erosion—install an outlet stabilization structure.

Seepage or poor drainage in swale; results in poor vegetation establishment—install subsurface drains or stone channel bottom.

Temporary Swale

Right-of-Way Diversions
(Water Bars)

Practice Description

Temporary ridges or combination ridges and excavated channels designed to shorten the flow length within a sloping right-of-way, thereby reducing the erosion potential by diverting storm runoff to a stabilized outlet. This practice applies to sloping right-of-ways or other long, narrow sloping areas such as utility access clearings.

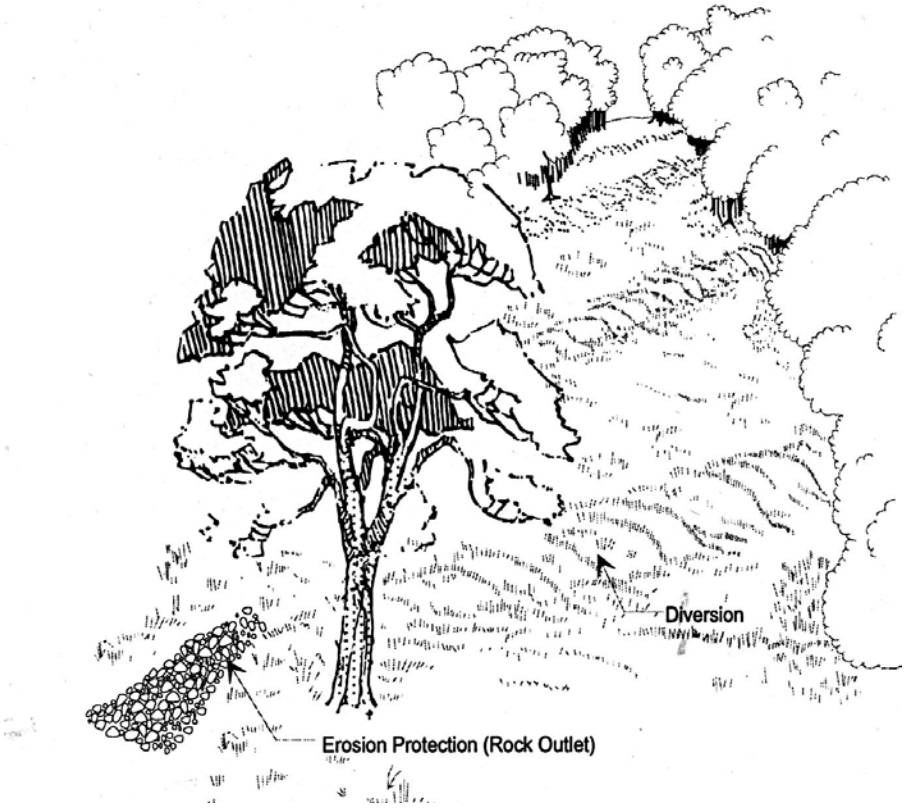


Figure 5.18 Typical Right-of-Way Diversion

Recommended Minimum Requirements

Prior to start of construction, right-of-way diversions should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process. The diver-

sions should be built according to planned alignment, grade and cross section.

- **Height:** 18 inches
- **Side Slopes:** 2:1 or flatter; 3:1 or flatter where vehicles cross
- **Base Width of Ridge:** 6 feet
- **Spacing:** Spacing as given in Table 5.14
- **Grade:** Stable, positive grade towards outlet, but less than 2%.
- **Outlet:** Right-of-way diversion must cross full access width and extend to a stable outlet.

Table 5.14 Recommended Spacing of Water Bar Diversions

Slope	Diversion Spacing (ft)
Less than 5%	125
5 to 10%	100
10 to 20%	75
20 to 35%	50
Greater than 35%	25

Source: North Carolina Field Manual, 1991

Construction

Site Preparation

Determine exact location of underground utilities.

Clear the access right-of-way and grade as necessary.

Construct sediment traps or outlet stabilization structures as needed.

Locate the first bar at the required distance from the slope crest depending on steepness of the right-of-way slope (Table 5.14). Set the crossing angle so as to maintain a positive grade of less than 2%.

Set the direction of the right-of-way diversions to utilize the most stable outlet locations. If necessary, adjust length of and/or spacing between bars to prevent runoff from upslope bars from merging with downslope water bar outlets.

Grading

Mark the location and width of the ridge, and scarify the entire length.

Excavate, fill and shape the diversion to planned alignment, grade and cross section.

Fill the ridge to above the design height, then compact with rubber-tired equipment down to the design height.

Erosion Control

Establish vegetation on the ridge and channel immediately following construction.

Construction Verification

Verify the dimensions shown on the plans for height, base width, channel depth, grade and side slopes.

Check all of the finished grades and configuration of all channels to eliminate constrictions to flow. Also check all ridges for low spots and stability.

Troubleshooting

Consult with a qualified design professional if the following occurs:

- Variations in topography on site indicate right-of-way diversions will not function as intended.

Maintenance

Inspect right-of-way diversions after storm events for erosion and sediment deposition and periodically for vehicle wear.

Remove debris and sediment from channels and sediment traps or basins.

Repair ridges to grade and planned height.

Add gravel at crossing areas and stabilize outlets as needed.

Repair and establish vegetation on right-of-way diversions immediately after installation of additional utilities in the right-of-way.

To remove temporary right-of-way diversions, grade the ridge and channel to blend with the natural ground, compact the channel fill and establish vegetation on disturbed areas. (Do not remove right-of-way diversions until all disturbed areas draining to them are stabilized).

Common Problems

Diversion spacing is too wide for slope; results in gully erosion between right-of-way diversions—install additional bars.

Surface is not stable; results in ridge worn down and channel filled where vehicles cross—stabilize using gravel or other surface treatment.

Erosion at outlets—install an outlet stabilization structure or extend the upslope bars so runoff will not converge on the lower outlets.

Grade is too steep; results in erosion in channel—realign the right-of-way diversion to reduce grade.